1. A brushless hybrid electrical machine for converting between electrical and mechanical energy comprising:

a rotor supported for rotation about an axis of rotation relative to a juxtaposed stator that is stationary and magnetically interacts with said rotor;

said rotor includes a ferromagnetic rotor structure having poles around a circumference, said poles arranged in a circumferentially alternating array of ferromagnetic and permanent magnet poles;

said ferromagnetic and permanent magnet poles facing a magnetic air gap created in said ferromagnetic structure;

said stator having a stationary air core armature located in said magnetic air gap, said air core armature comprising windings;

said stator including a field coil that generates field coil flux that flows in a flux path through said ferromagnetic poles, said magnetic air gap and through said ferromagnetic rotor structure;

said permanent magnet poles generate permanent magnet flux;

whereby said field coil flux and said permanent magnet flux induces an AC voltage in said windings of said air core armature as said rotor rotates.

2. A brushless hybrid electrical machine as described in claim 1 wherein:

said permanent magnet flux flows mostly axially and radially through said ferromagnetic rotor structure when the field current to said field coil is off and when said field current has a polarity such that said field current bucks said induced AC voltage in said multiple phase windings of said air core armature.

3. A brushless hybrid electrical machine as described in claim 2 wherein:

said electrical machine is free of laminations.

4. A brushless hybrid electrical machine for converting between electrical and mechanical energy comprising: a rotor supported for rotation about an axis of rotation relative to a juxtaposed stator that is stationary and magnetically interacts with said rotor;

said rotor includes a ferromagnetic rotor structure having poles around a circumference, said poles arranged in a circumferential array of ferromagnetic and permanent magnet poles;

said ferromagnetic and permanent magnet poles facing a magnetic air gap created in said ferromagnetic structure;

said stator having a stationary air core armature located in said magnetic air gap, said air core armature comprising windings;

said stator including a field coil that generates field coil flux that flows in a flux path through said ferromagnetic poles, said magnetic air gap and through said ferromagnetic rotor structure;

said permanent magnet poles generate permanent magnet flux;

whereby said field coil flux and said permanent magnet flux induces an AC voltage in said windings of said air core armature as said rotor rotates.

5. A brushless hybrid electrical machine as described in claim 4 wherein:

said permanent magnet flux flows in a path primarily excluding said ferromagnetic poles when said field coil is off.

6. A brushless hybrid electrical machine as described in claim 5 wherein:

application of current to said field coil bucks or boosts the AC voltage induced in said windings depending on the polarity of the current to said field coil.

7. A brushless hybrid electrical machine as described in claim 5 wherein:

said brushless hybrid electrical machine converts between electrical and mechanical energy in a flywheel energy system.

8. A brushless hybrid electrical machine as described in claim 4 wherein:

said rotor comprises a magnetic insulating structure that separates two portions of said ferromagnetic rotor structure such that each portion bounds opposite sides of said magnetic airgap.

9. A brushless hybrid electrical machine for converting between electrical and mechanical energy comprising: a rotor supported for rotation about an axis of rotation relative to a juxtaposed stator that is stationary and magnetically interacts with said rotor;

said rotor includes a ferromagnetic rotor structure having poles around a circumference, said poles arranged in a circumferential array of ferromagnetic and permanent magnet poles;

said ferromagnetic and permanent magnet poles facing a magnetic air gap;

said stator having a stationary air core armature located in said magnetic air gap, said air core armature comprising windings;

said brushless hybrid electrical machine further comprising a field coil that generates field coil flux that flows in a flux path through said ferromagnetic poles, said magnetic air gap and through said ferromagnetic rotor structure; said permanent magnet poles generate permanent magnet flux;

whereby said field coil flux and said permanent magnet flux induces an AC voltage in said windings of said air core armature as said rotor rotates.

10. A brushless hybrid electrical machine as described in claim 9 wherein:

said magnetic airgap is bounded on both sides by rotating surfaces of said rotor.

11. A brushless hybrid electrical machine as described in claim 10 wherein:

said brushless hybrid electrical machine comprises only a single magnetic airgap.

12. A brushless hybrid electrical machine as described in claim 11 wherein:

said field coil is supported by said rotor.

13. A brushless hybrid electrical machine as described in claim 11 wherein:

said field coil is supported by said air core armature.

14. A brushless hybrid electrical machine as described in claim 10 wherein:

said circumferential array of ferromagnetic and permanent magnet poles comprises a circumferential alternation of permanent magnet and ferromagnetic poles.

15. A brushless hybrid electrical machine as described in claim 10 wherein:

said circumferential array of ferromagnetic and permanent magnet poles comprises a circumferential array of alternating polarity of permanent magnet poles.

16. A brushless hybrid electrical machine as described in claim 15 wherein:

said permanent magnet flux flows primarily between said alternating polarity permanent magnet poles in said rotor.

17. A brushless hybrid electrical machine as described in claim 15 wherein:

said ferromagnetic poles are located adjacent permanent magnet poles of one polarity.

18. A brushless hybrid electrical machine as described in claim 15 wherein:

said alternating polarity permanent magnet poles are arranged such that one polarity of permanent magnet pole has a shorter circumferential length than the other.

19. A brushless hybrid electrical machine as described in claim 10 wherein:

said permanent magnet poles are located on both sides of said magnetic airgap.

20. A brushless hybrid electrical machine as described in claim 9 wherein:

said air core armature is wound such that AC voltage induced in said windings is sinusoidal.